NASA Technical Memorandum 2003–206892, Volume 22

# SeaWiFS Postlaunch Technical Report Series

Stanford B. Hooker, Editor
*NASA Goddard Space Flight Center, Greenbelt, Maryland*

Elaine R. Firestone, Senior Scientific Technical Editor
*Science Applications International Corporation, Beltsville, Maryland*

# Volume 22, Algorithm Updates for the Fourth SeaWiFS Data Reprocessing

Frederick S. Patt, Robert A. Barnes, Robert E. Eplee, Jr., Bryan A. Franz, and Wayne D. Robinson
*Science Applications International Corporation, Beltsville, Maryland*

Gene Carl Feldman
*NASA/Goddard Space Flight Center, Greenbelt, Maryland*

Sean W. Bailey and Joel Gales
*Futuretech Corporation, Greenbelt, Maryland*

P. Jeremy Werdell
*Science Systems and Applications, Incorporated, Lanham, Maryland*

Menghua Wang
*University of Maryland, Baltimore County, Baltimore, Maryland*

Robert Frouin
*Scripps Institution of Oceanography, La Jolla, California*

Richard P. Stumpf
*NOAA Center for Coastal Monitoring and Assessment, Silver Spring, Maryland*

Robert A. Arnone, Richard W. Gould, Jr., and Paul M. Martinolich
*Naval Research Lab, Stennis, Mississippi*

Varis Ransibrahmanakul
*SPS Technologies, Silver Spring, Maryland*

John E. O'Reilly
*NOAA National Marine Fisheries Service, Narragansett, Rhode Island*

James A. Yoder
*University of Rhode Island, Narragansett, Rhode Island*

# *Chapter 5*

## Changes to the Atmospheric Correction Algorithm and Retrieval of Oceanic Optical Properties

Bryan A. Franz and Robert E. Eplee, Jr.
*Science Applications International Corporation*
*Beltsville, Maryland*

Sean W. Bailey
*Futuretech Corporation*
*Greenbelt, Maryland*

Menghua Wang
*University of Maryland, Baltimore County*
*Baltimore, Maryland*

Abstract

In preparation for the fourth SeaWiFS reprocessing, a series of algorithm changes were implemented to enhance the performance of the atmospheric correction process and to improve the quality and consistency of oceanic optical property retrievals. Included in these changes was the introduction of a filtering process to reduce the relative noise between the two NIR channels. In addition, several modifications were made to improve the handling of the SeaWiFS out-of-band response, and the normalization of water-leaving radiances was extended to account for Fresnel transmittance effects through the air–sea interface. These and other algorithm updates are described within this chapter.

## 5.1 INTRODUCTION

While the general approach to SeaWiFS atmospheric correction over oceans did not change for the fourth reprocessing, a number of refinements were implemented and evaluated. Several of these modifications were found to yield significant improvement in the quality and consistency of oceanic optical property retrievals; the changes were included in the final reprocessing software and are discussed in detail in this chapter:

a) A filtering scheme for reducing aerosol model selection noise,
b) A modification to improve algorithm performance in very clear atmospheres,
c) Updates to the corrections for out-of-band response,
d) An extension of the water-leaving radiance normalization to account for Fresnel transmittance through the air–sea interface, and
e) A fix for aerosol model ambiguity problems.

## 5.2 RELATIVE NOISE REDUCTION

The SeaWiFS atmospheric correction algorithm (Gordon and Wang 1994) relies on the single-scattering aerosol reflectance ratio ($\epsilon$) between the two NIR bands at 765 and 865 nm to select the aerosol type. The atmospheric correction is, therefore, highly sensitive to any relative noise between these two NIR channels. A filtering technique was developed to reduce the relative noise in the NIR band ratio, which thereby reduces the small scale variability in aerosol model selection. The smoothing filter adjusts the radiance in the 765 nm channel to minimize local variability in the observed NIR aerosol ratio (i.e., the multiscattering equivalent of atmospheric $\epsilon$, i.e., $\epsilon_{\mathrm{ms}}$), while leaving the 865 nm radiance (which governs aerosol concentration) unchanged. The effect of this smoothing is to reduce pixel-to-pixel variability in the retrieved aerosol type, which ultimately reduces atmospheric correction noise in the retrieved water-leaving radiances.

The effect of this filtering can easily be seen in level-2 images of $\epsilon$, the Ångström coefficient, and, to a lesser extent, aerosol optical thickness at 865 nm. The value of this smoothing will diminish with increasing spatial and temporal averaging, and is more readily seen as reduced speckling in level-2 oceanic and atmospheric optical property retrievals. The smoothing was found to induce no bias-change in either the aerosol optical thickness or the water-leaving radiances.